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(52) UK CL (Edition O)
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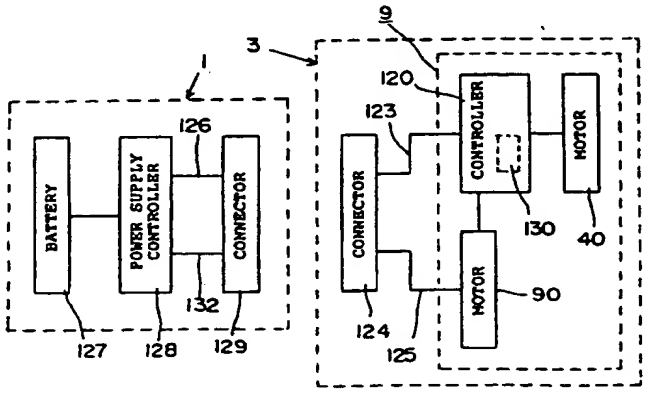
(54) Door lock apparatus with automatic door closing

(57) A door lock apparatus for a door adapted to slide on a vehicle body so as to be opened and closed, comprising; a power supply unit provided on the vehicle body and having a first controller 128 connected to an electric battery and a first connector 129 connected to the first controller, said first connector having a first terminal group consisting of a positive terminal exposed to the outside, an earth terminal, and a signal terminal; a power receiving unit provided on the door and having a second connector 124 and a second controller 120 connected to the second connector, said second connector having a second terminal group consisting of a positive terminal exposed to the outside, a earth terminal, and a signal terminal, said second terminal group being adapted to mutually, contact with the first terminal group when the door is closed to a predetermined position; a latch provided on the door so as to engage with a striker secured to the vehicle body; a first motor connected to the second controller so as to rotate the latch towards a full-latched position when the motor rotates in a given direction; wherein the first controller 128 is adapted to apply a predetermined voltage to a signal terminal of the first terminal group and to supply an electric current to the earth terminal of the first t rminal group from the signal terminal of the first terminal group through the second controller when the first terminal group comes into mutual contact with the second terminal group, and the arrangement being such said first controller supplies power of the battery to the second controller, when the first controller causes current to flow to the earth terminal, through both positive terminals.

FIG. 27



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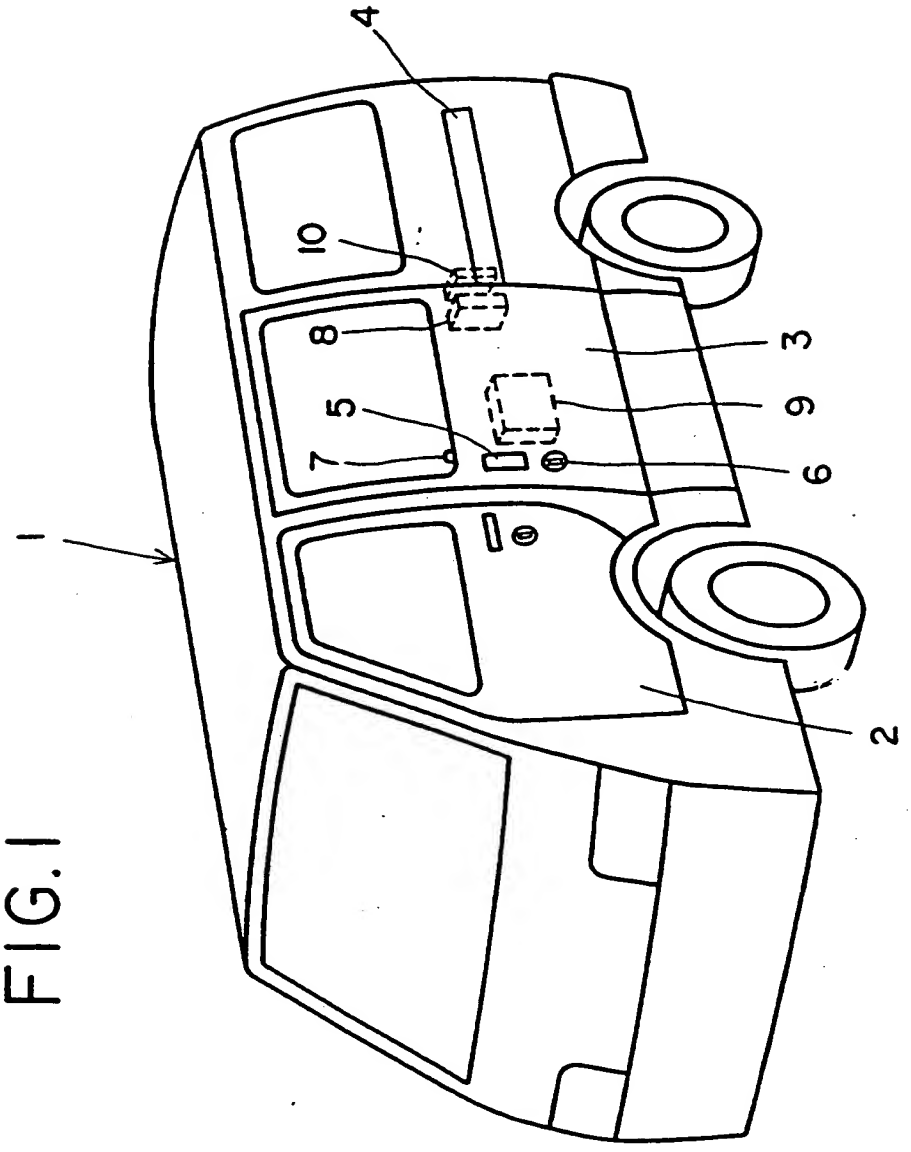
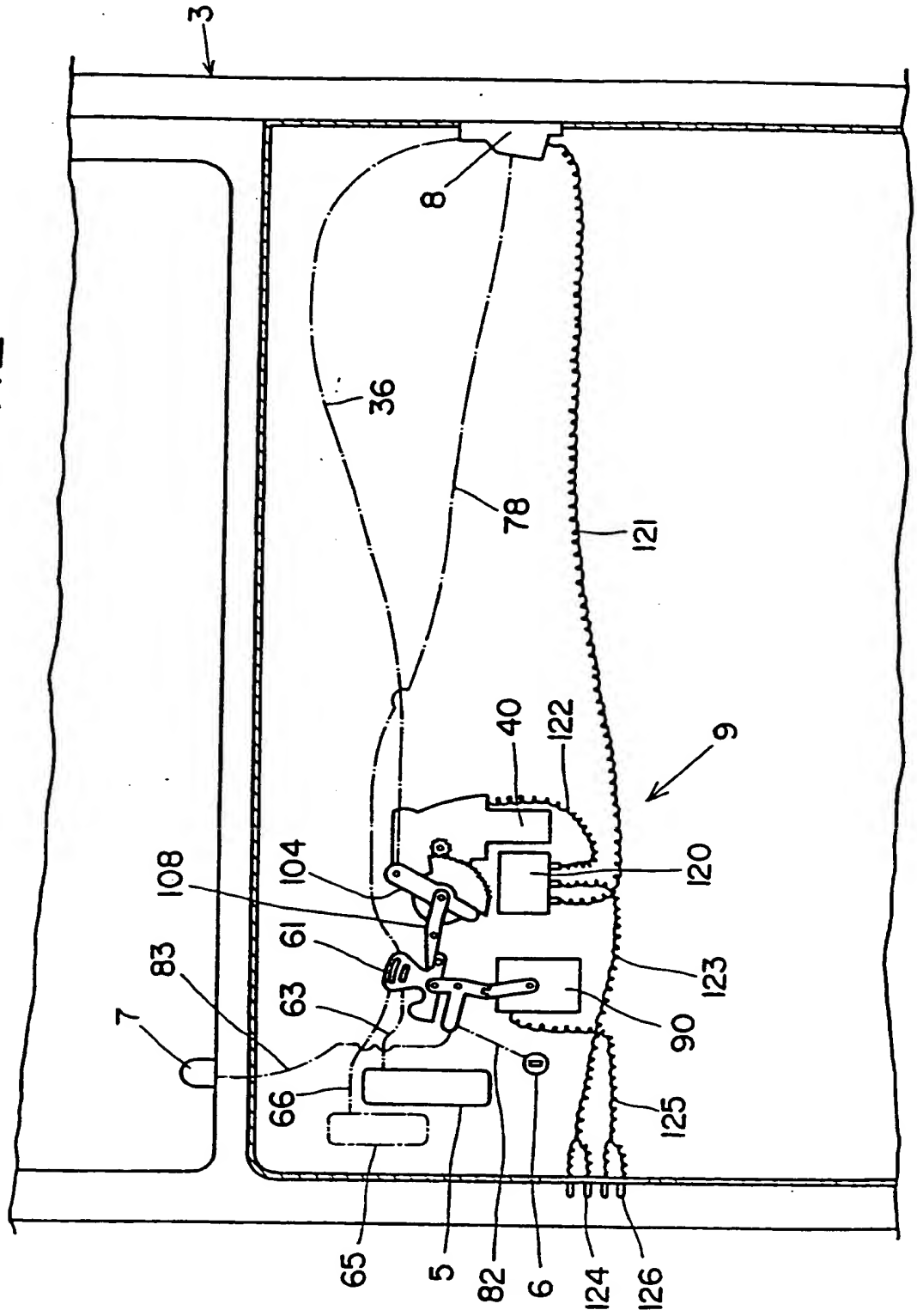


FIG. 1

FIG.2


3
8
36
78
121
40
122
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108
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120
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7
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5
82
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124
126

FIG.3

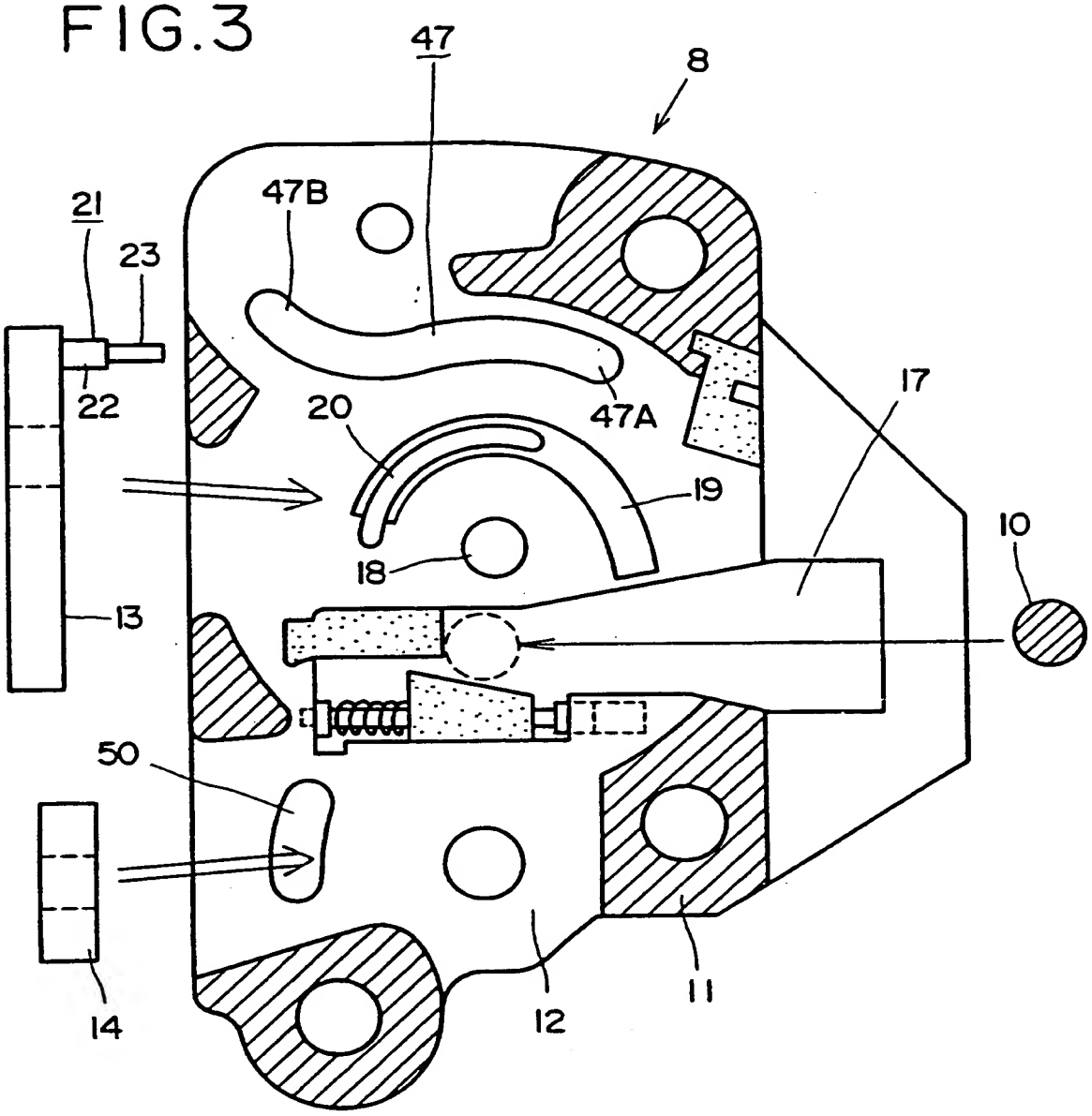
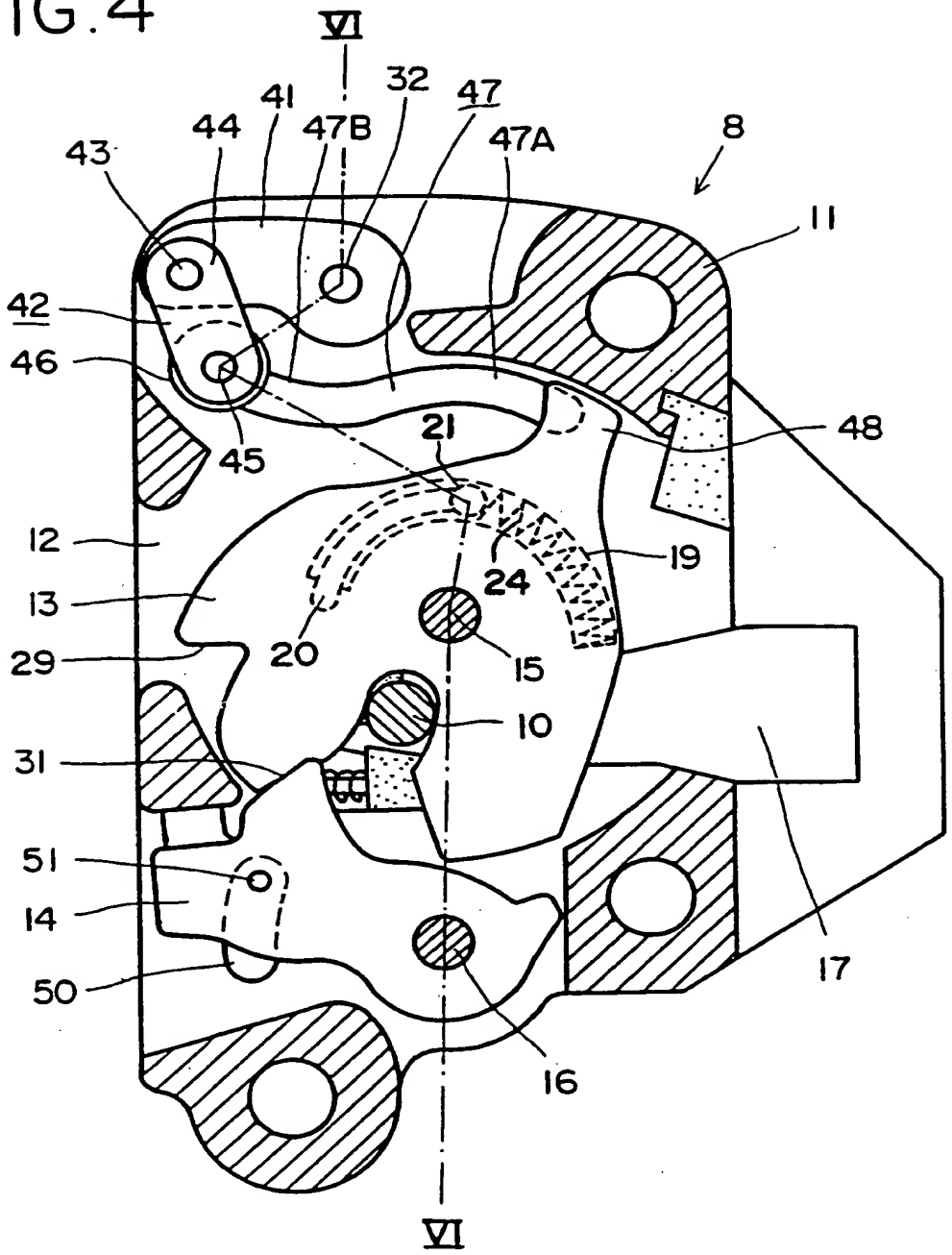


FIG.4


VI
41
32
47
44
47B
47A
8
43
11
42
46
48
21
45
12
19
24
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20
15
29
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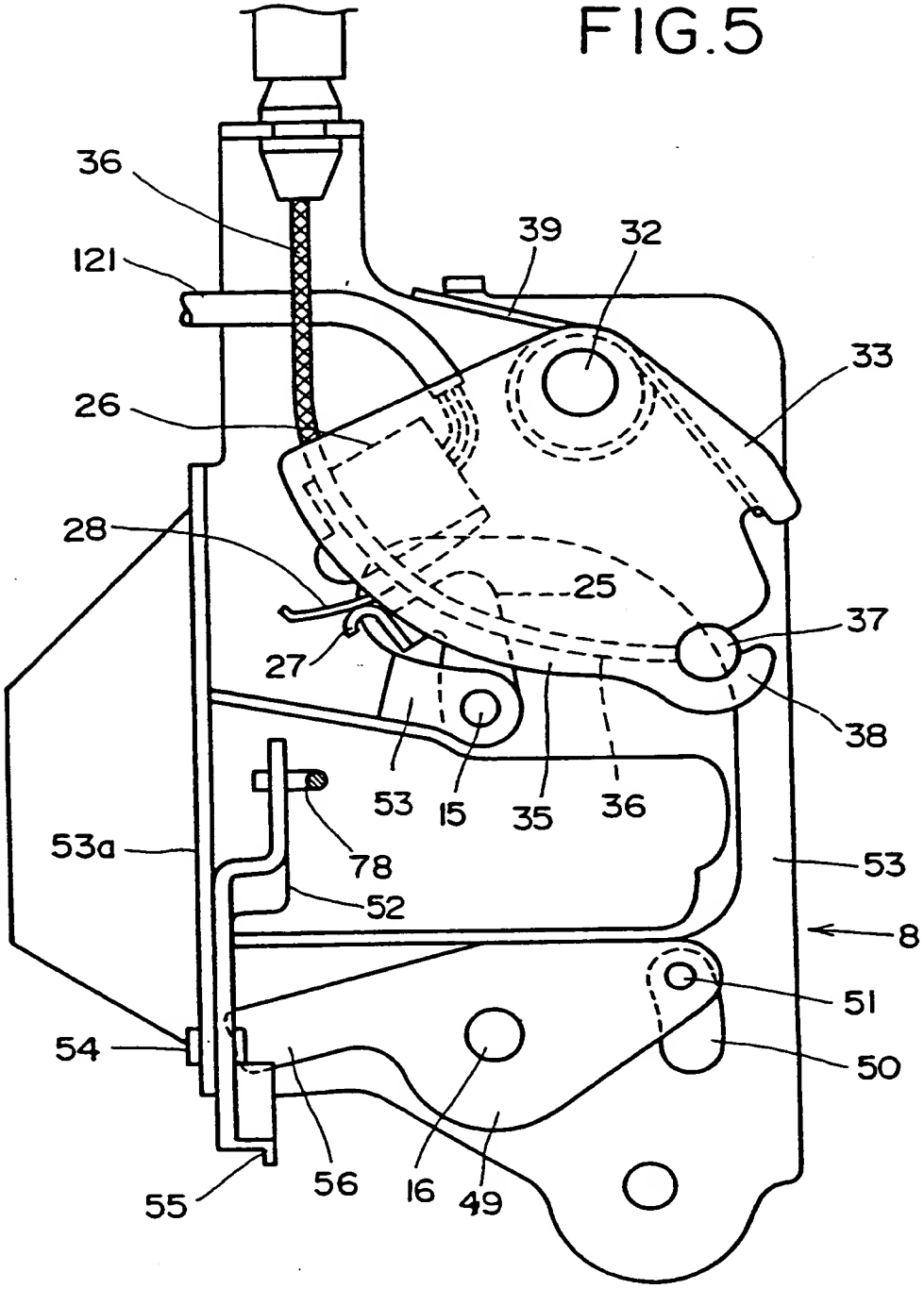
14
17
50
16
VI

FIG.5


36
121
39
32
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25
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27
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53
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53a
78
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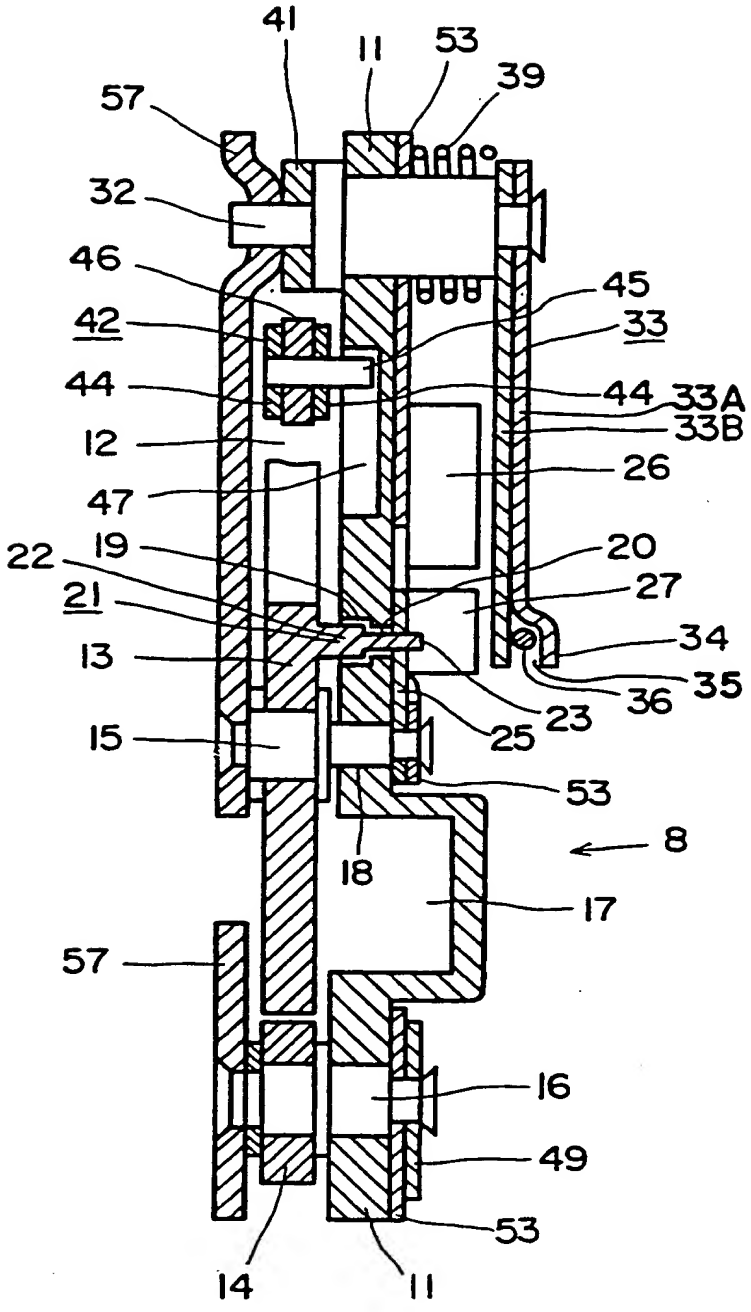
16
49

FIG.6


41
11
53
39
57
32
46
45
42
33
44
44
33A
33B
12
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47
22
19
20
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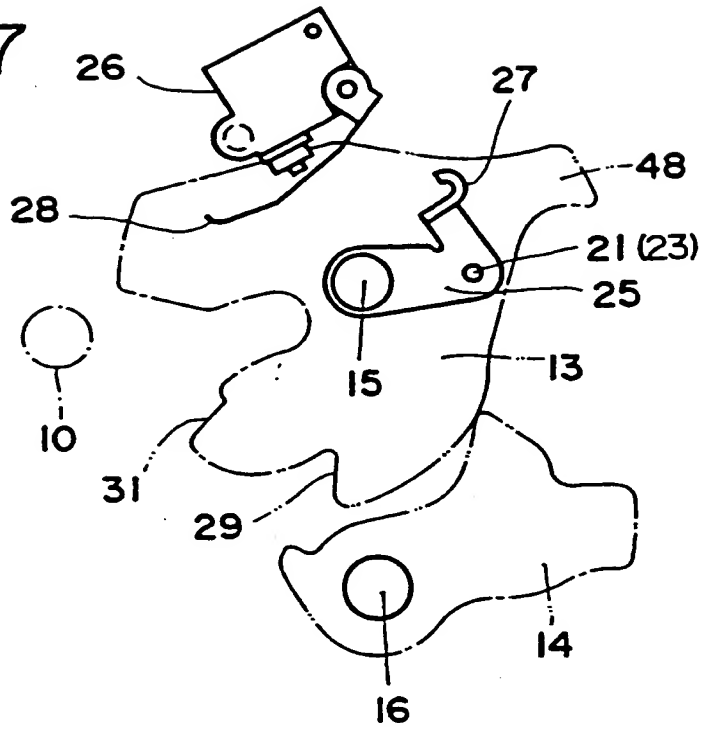
14
11

FIG.7


26
27
48
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21 (23)
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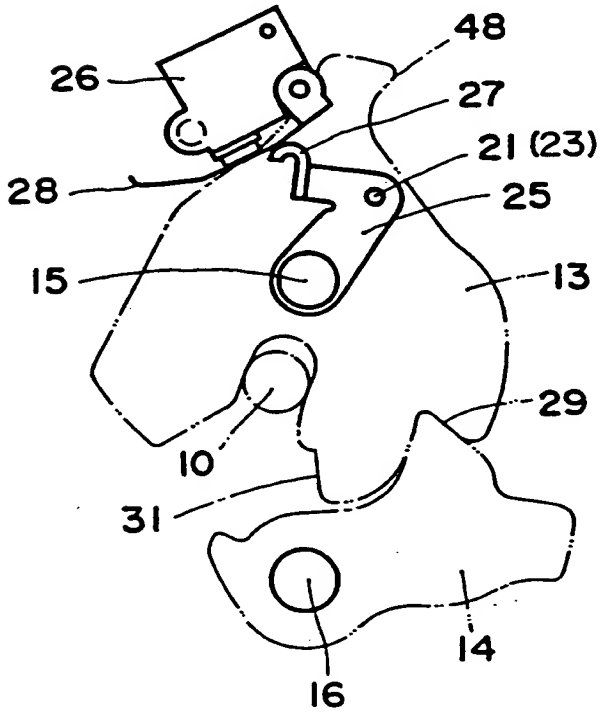
14
16

FIG.8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26
27
21 (23)
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25
15
13
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31
14
16

FIG.9

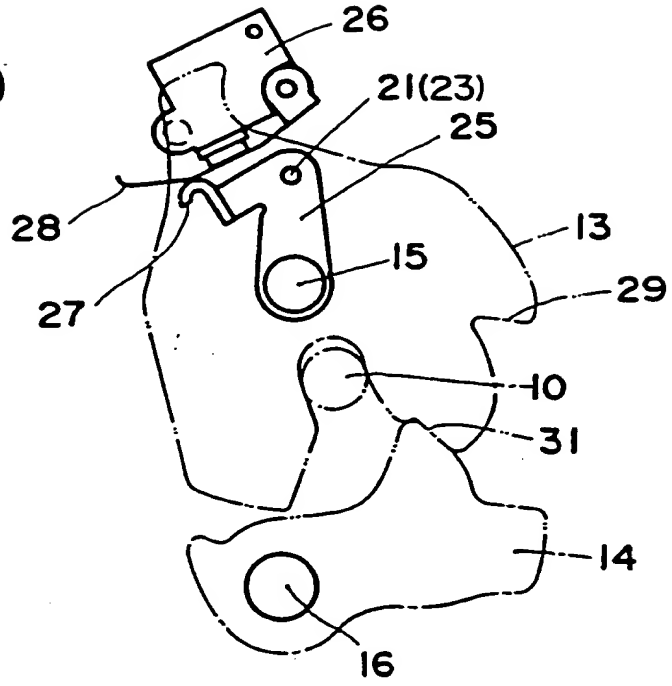
26
21(23)
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FIG.10

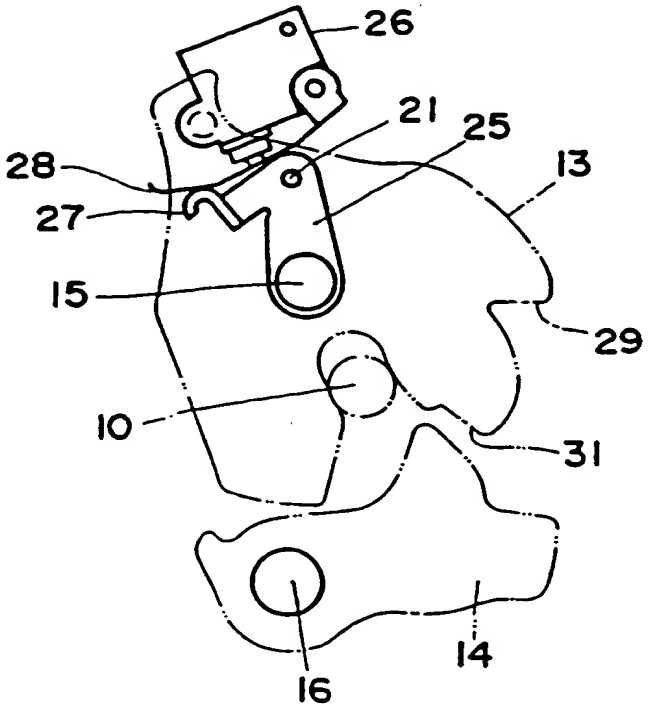
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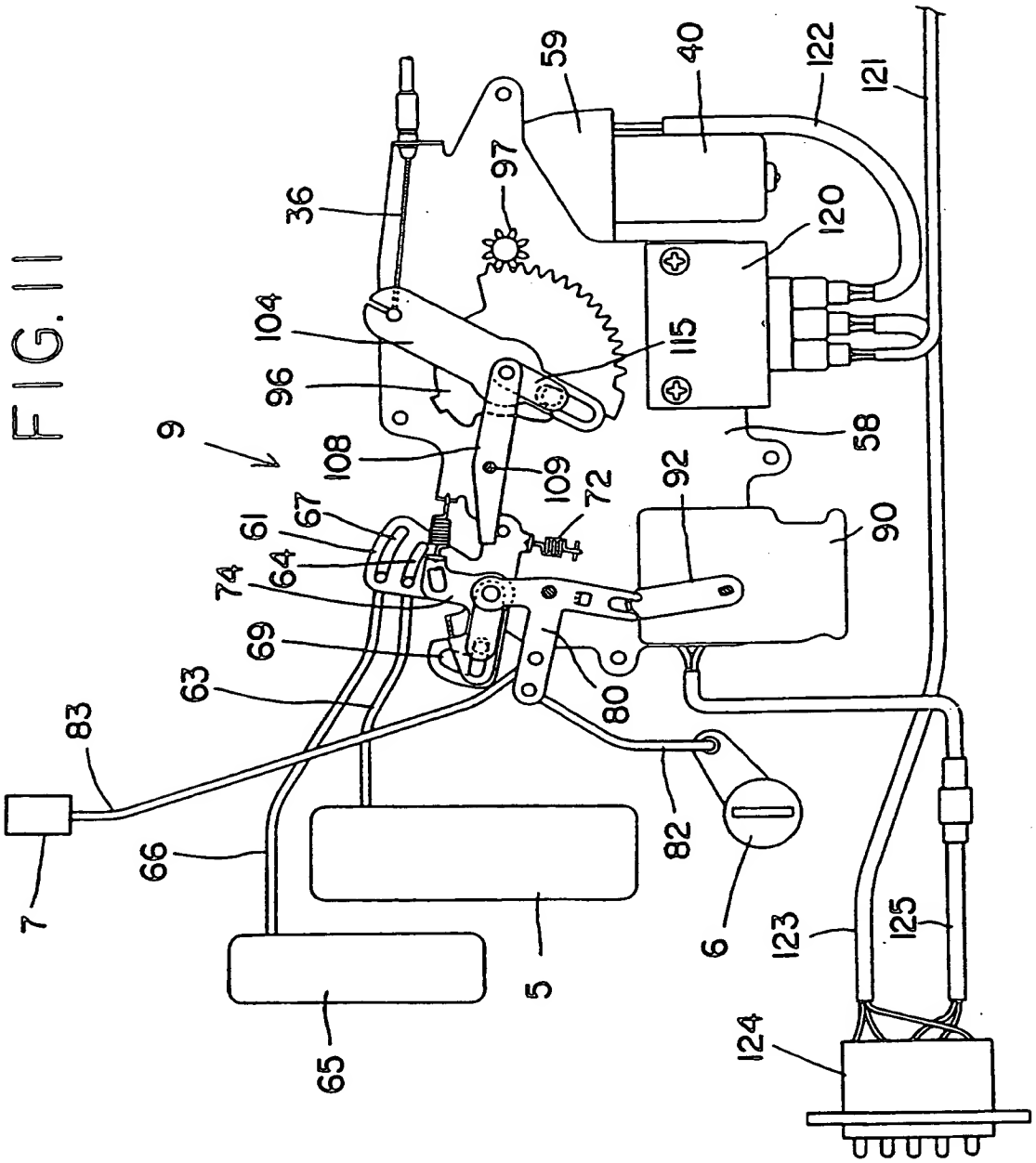
FIG. 11


59
40
122
121
97
36
120
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96
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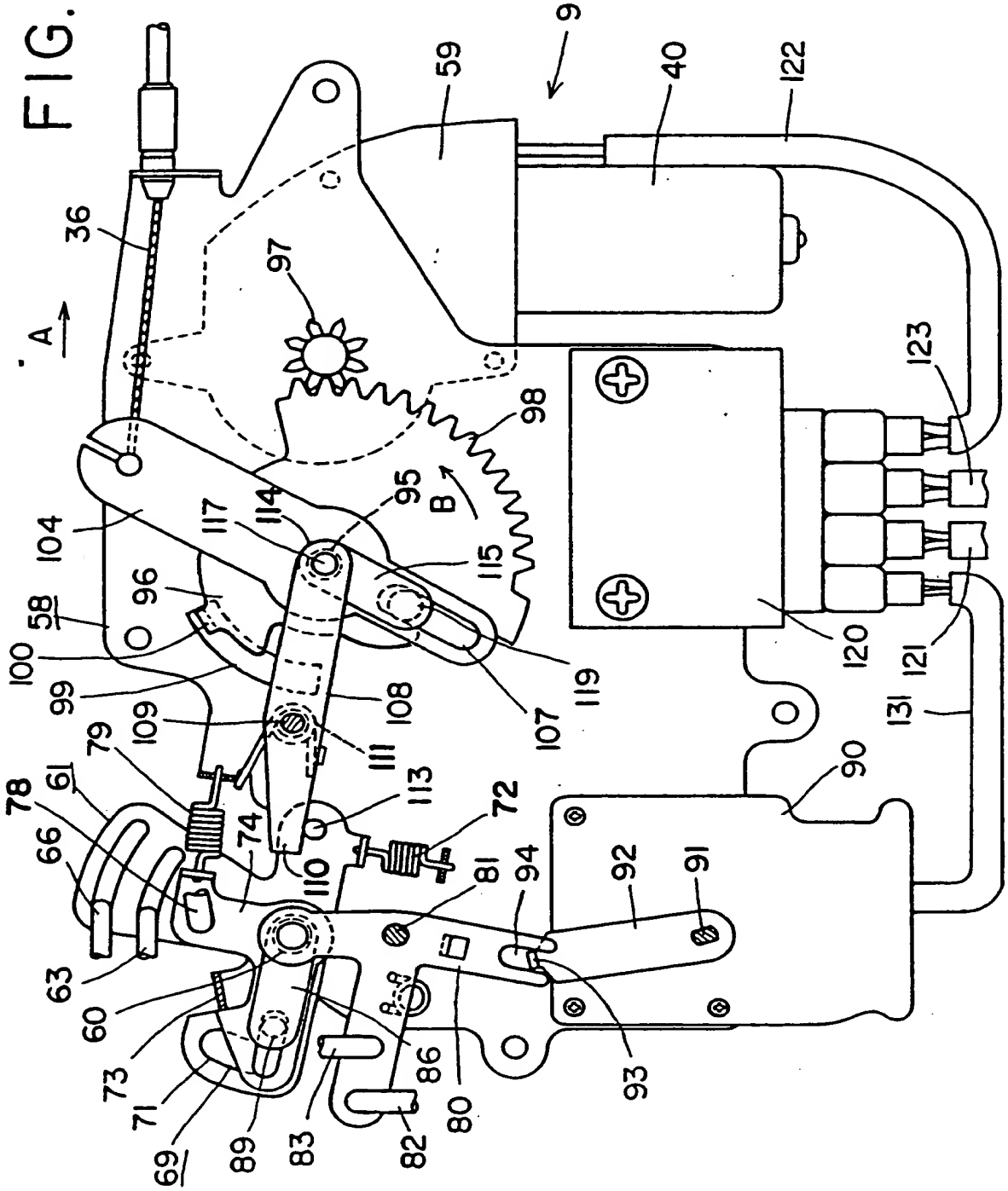
FIG. 12


9
59
40
122
36
97
A
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B
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109
111
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110
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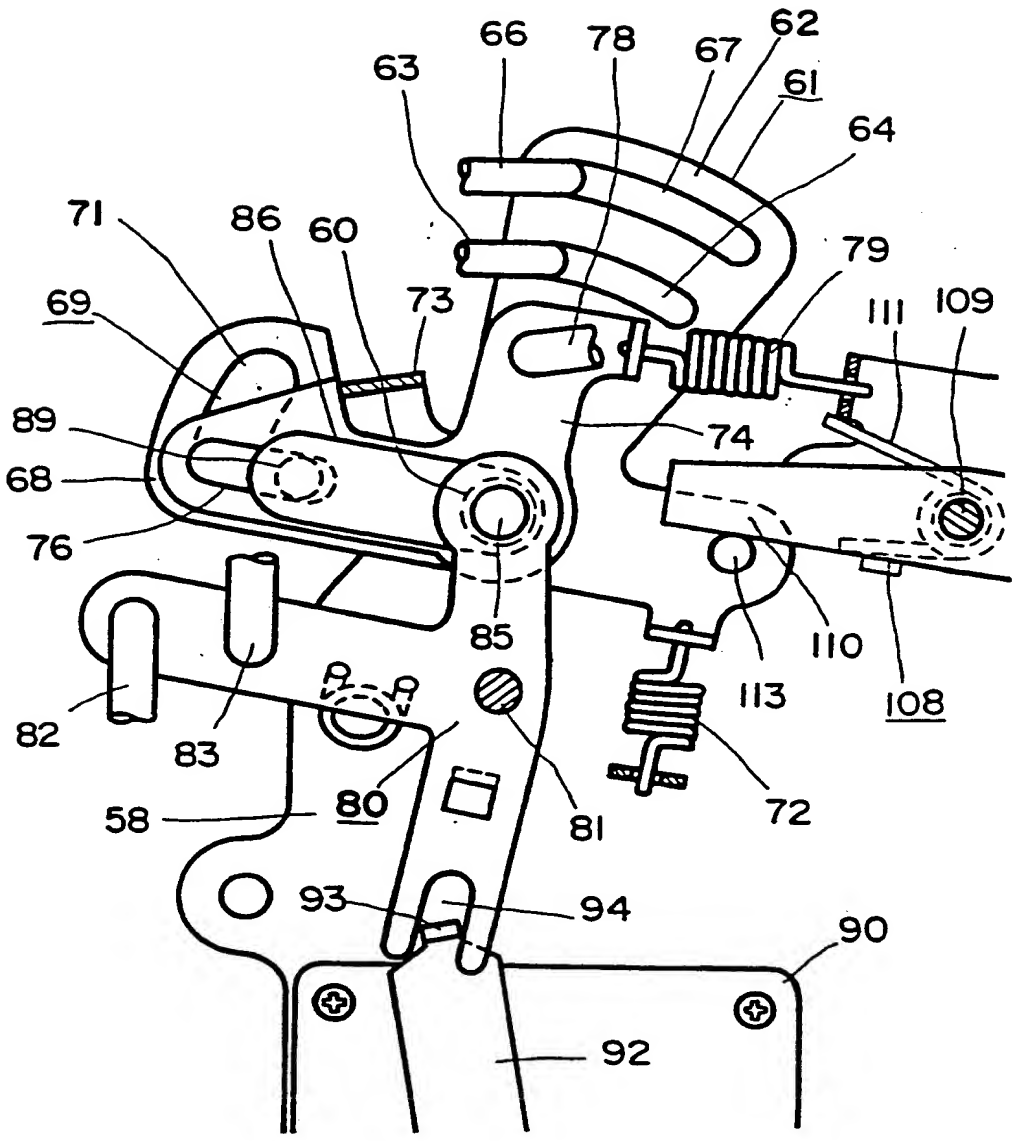
131

FIG. 13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92

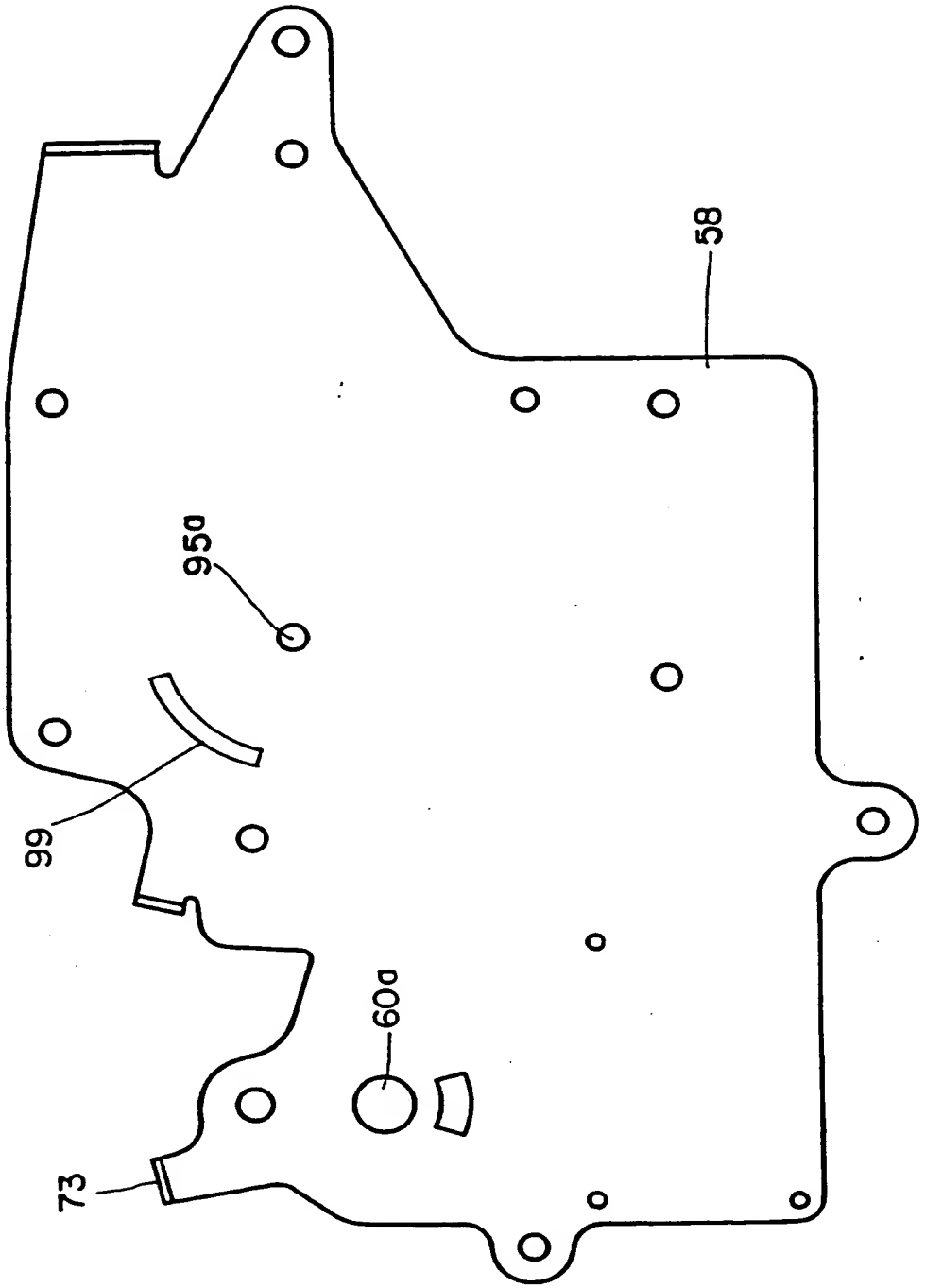


FIG. 14

FIG. 15

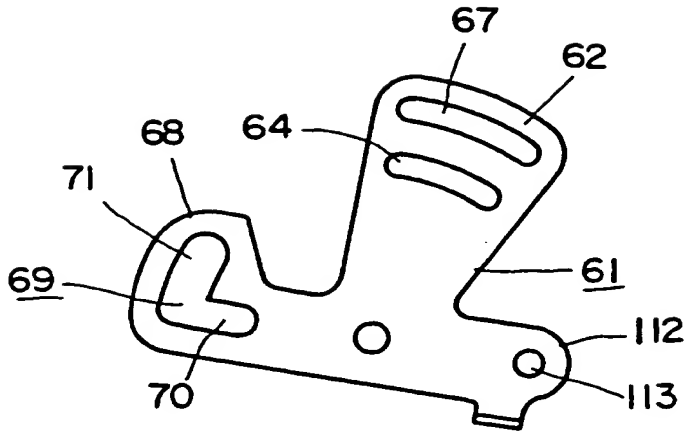


FIG. 16

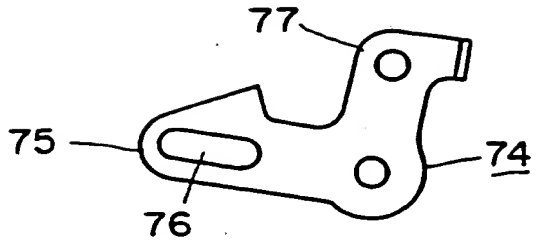


FIG. 17

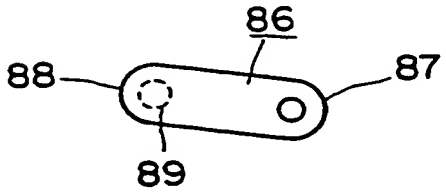


FIG. 18

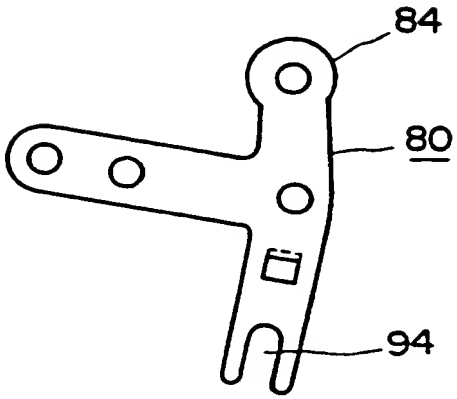


FIG. 19

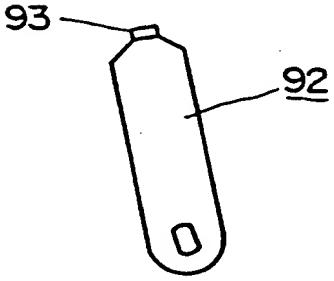


FIG. 20

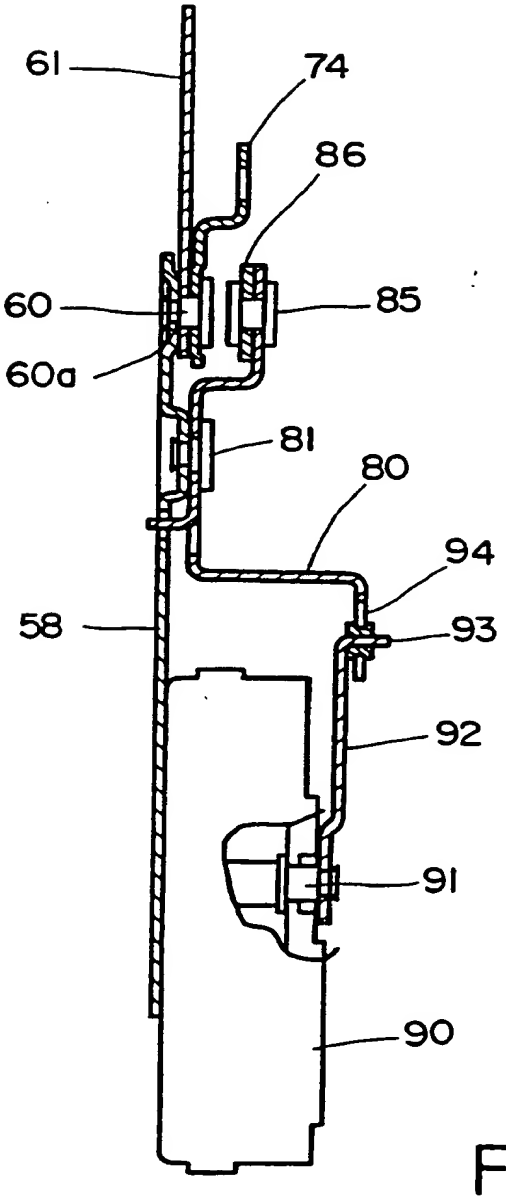


FIG. 22

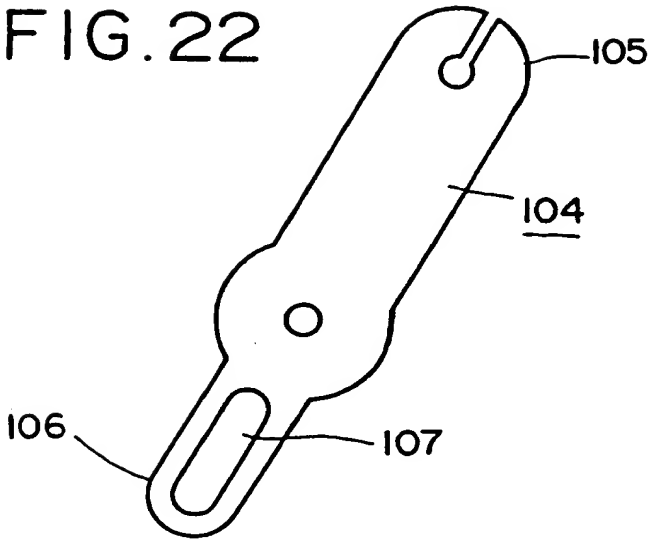


FIG. 23

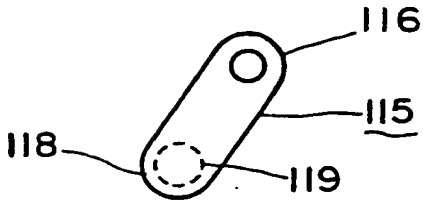


FIG. 24

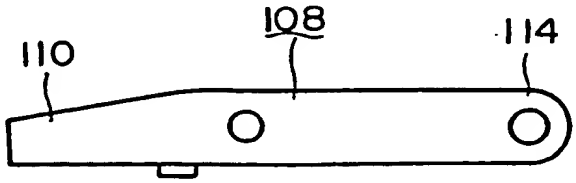


FIG. 21

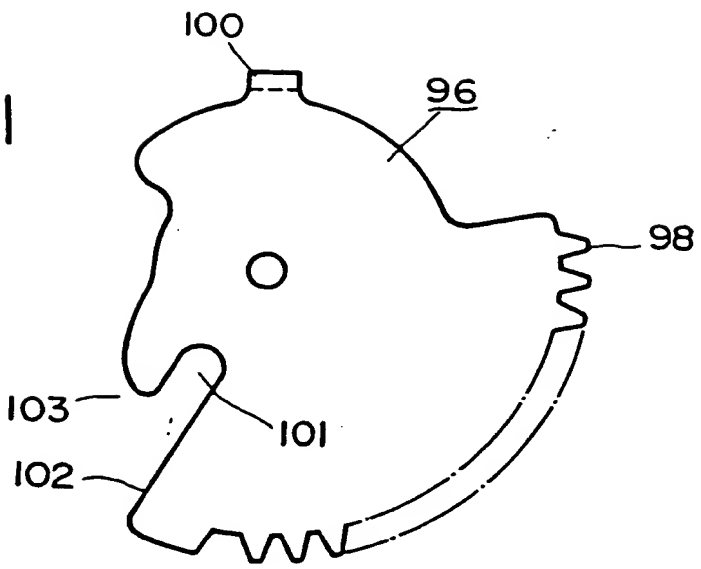

100
96
98
103
101
102

FIG. 25

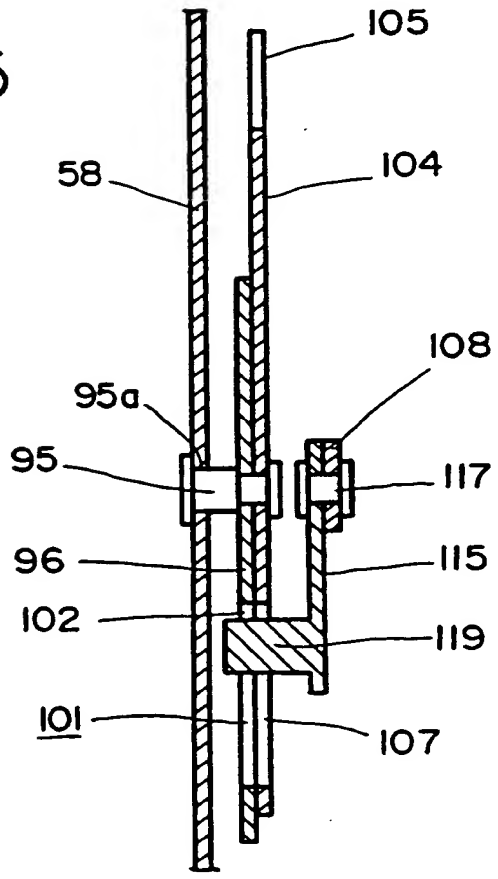

105
58
104
108
95a
95
117
96
115
102
119
101
107

FIG. 26

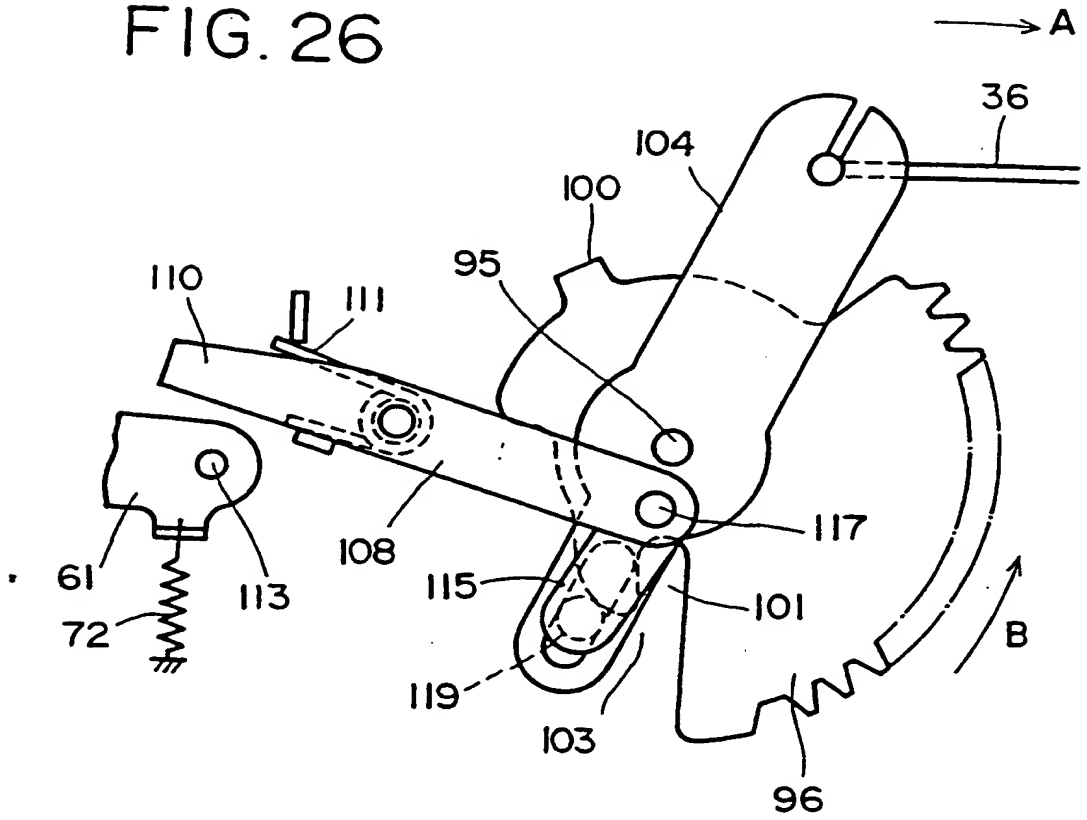

A
36
104
100
95
110
111
117
108
61
113
115
101
72
B
119
103
96

FIG. 27

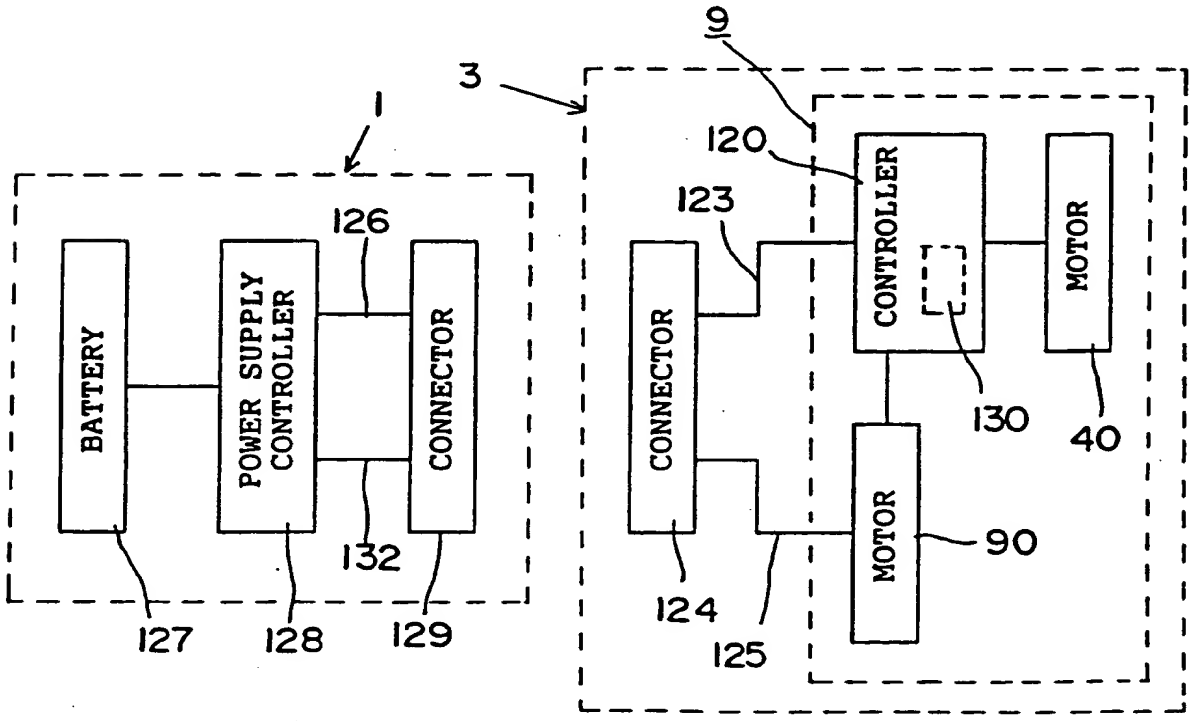
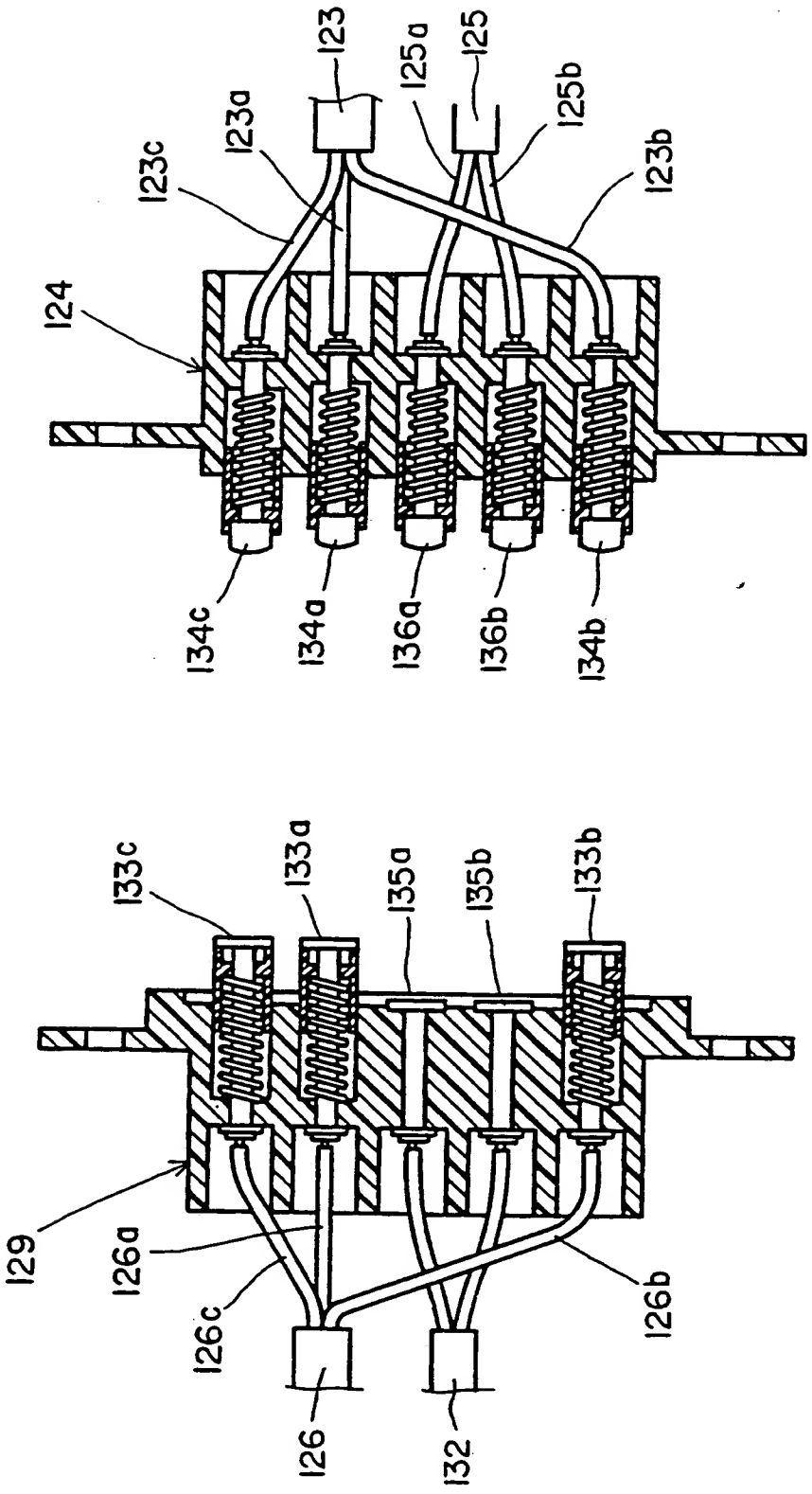

9
3
1
120
123
126
CONTROLLER
MOTOR
BATTERY
POWER SUPPLY CONTROLLER
CONNECTOR
CONNECTOR
130
40
MOTOR
90
132
124
125
127
128
129

FIG. 28


123
125a
125
125b
123a
123c
123b
124
134c
134a
136a
136b
134b
133c
133a
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135b
133b
129
126a
126c
126b
126
132

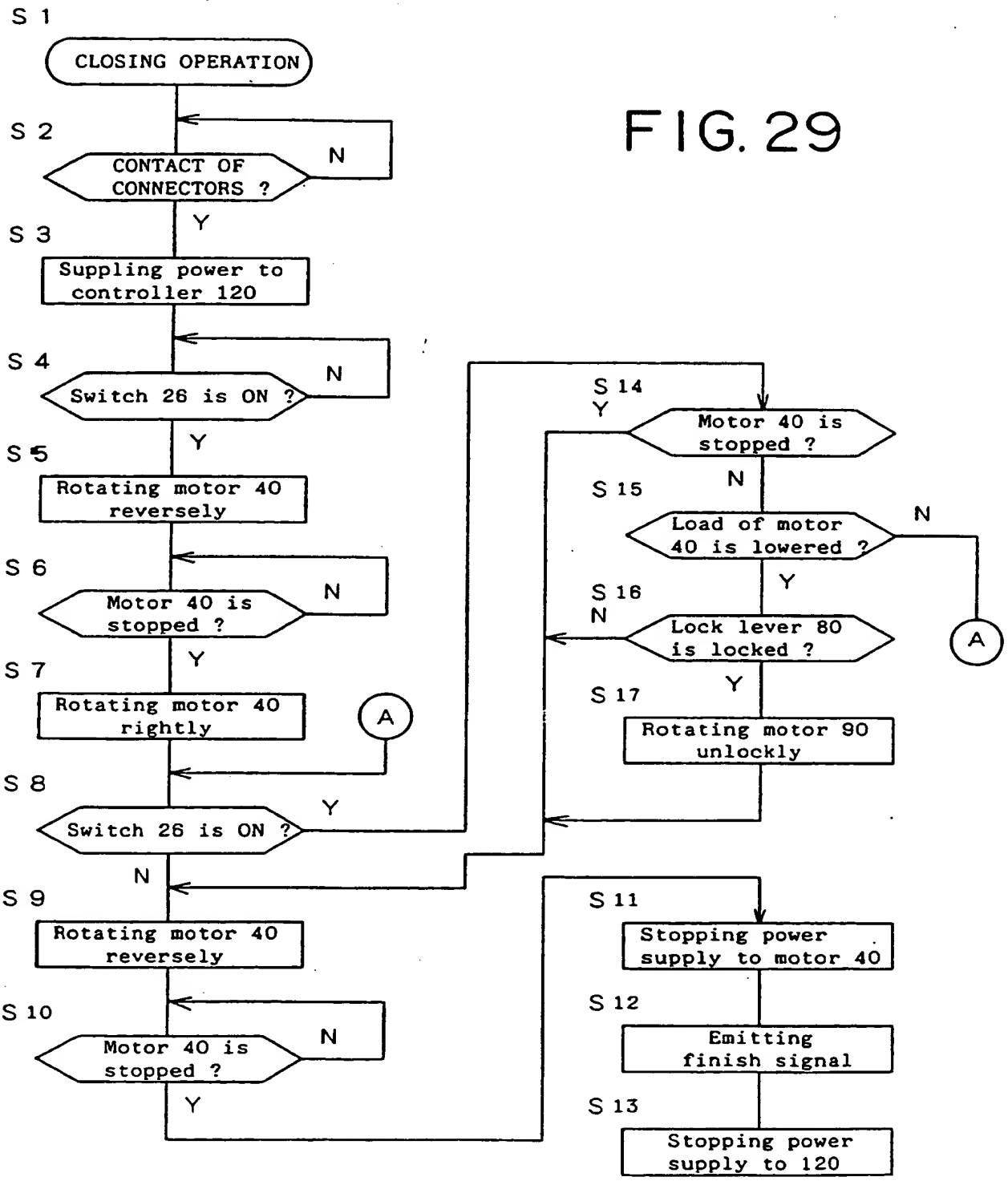
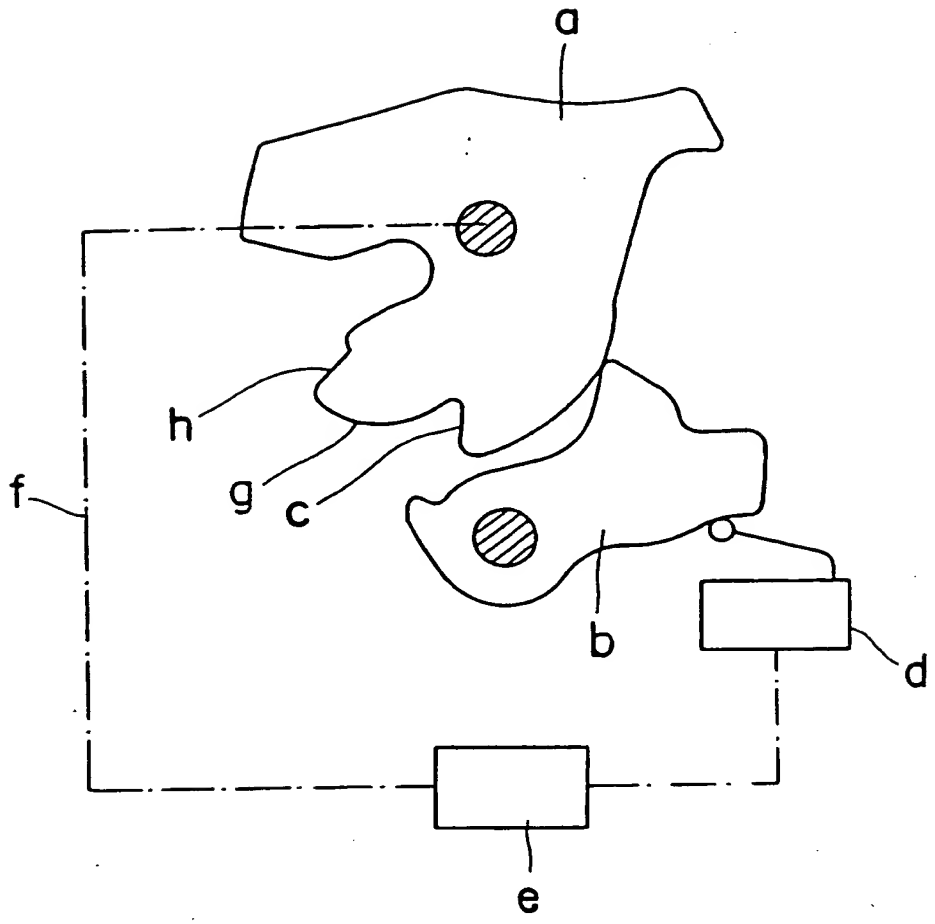

S 1
CLOSING OPERATION
S 2
CONTACT OF CONNECTORS ?
N
Y
S 3
Suppling power to controller 120
S 4
Switch 26 is ON ?
N
Y
S 5
Rotating motor 40 reversely
S 6
Motor 40 is stopped ?
N
Y
S 7
Rotating motor 40 rightly
A
S 8
Switch 26 is ON ?
Y
N
S 9
Rotating motor 40 reversely
S 10
Motor 40 is stopped ?
N
Y
S 14
Y
Motor 40 is stopped ?
N
S 15
Load of motor 40 is lowered ?
N
Y
S 16
N
Lock lever 80 is locked ?
A
Y
S 17
Rotating motor 90 unlockly
S 11
Stopping power supply to motor 40
S 12
Emitting finish signal
S 13
Stopping power supply to 120

FIG. 29

FIG. 30
(PRIOR ART)



2295642

DOOR LOCK APPARATUS WITH AUTOMATIC DOOR CLOSING MECHANISM

The present invention relates to a door lock apparatus with an automatic door closing mechanism enabling complete closing of the door using the power of a motor after the door has been manually closed to a predetermined point.

According to the conventional known door lock apparatus with automatic door closing mechanism described in Japanese Pat. Appln. Laid-open No. 3-115676, the apparatus comprises a latch engaging with a striker secured to the vehicle body, an automatic door closing motor, a power transmitting mechanism provided between the motor and the latch in order to forcibly rotate the latch towards its full-latched position when the motor rotates in a given direction, a switch detecting the latch at its half-latched position and its full-latched position, and a controller for controlling the motor on the basis of a signal issued from the switch. Said controller rotates the motor in the given direction when the switch detects the half-latched position so as to move the latch towards its full-latched position through the power transmitting mechanism and rotates the motor reversely when the switch detects the full-latched position.

A first problem of the conventional door lock apparatus relates to the construction of the switch for detecting the position of the latch. FIG. 30 depics the relation between the conventional switch and the latch.

When the door is manually closed and the latch (a) reaches its half-latched position, the ratchet (b) rotates counterclockwise and engages with an intermediate stepped portion (c) of the latch (a). When the ratchet (b) rotates, switch (d) turns ON, so that the motor (e) rotates in the given direction and the power transmitting mechanism (f) rotates the latch (a) reversely. After the latch (a) rotates, the ratchet (b) disengages the stepped portion (c) and rides on a slanted face (g) resulting in an OFF condition of the switch (d). When the latch (a) further rotates and reaches its full-latched position, the ratchet (b) engages with a main stepped portion (h). consequently, switch (d) turns ON again and the motor (e) rotates reversely returning the power transmitting mechanism (f) to its initial position.

According to the conventional known lock apparatus, the first ON condition of the switch (d) is considered as its half-latched condition and the next ON condition of the switch is considered as its full-latched condition. It is noted that it is not always that the second ON condition of the switch is its full-latched one. That is, when the door is closed with a relatively weak force, the latch (a) may return to its half-latched position after it rotates to a mid position between a half-latched position and a full-latched position. This is the reason for the door being not closed completely and being at its half-latched condition.

When the latch (a) rotates as described above, the

ratchet (b) engages with the intermediate stepped portion (c) and rides on a slanted face (g), then again engages with the intermediate stepped portion (c). Thereby, the switch (d) outputs an ON signal twice. In this condition, notwithstanding that the latch (a) is at its half-latched condition, the motor (e) reversely rotates and it is impossible to obtain a satisfactory or complete automatic door closing operation.

The second problem of the conventional door lock apparatus is that the motor is rotated in the given direction and the latch is rotated towards its full-latched position when the latch reaches its full-latched condition. As shown in FIG 30, a power transmitting mechanism (f) used also as a speed reduction mechanism is provided between the latch (a) and the motor (e). The power transmitting mechanism (f) sometimes fails to function if it doesn't return to its initial position when the motor (e) rotates in the given direction.

Some of the conventional door lock apparatus have been improved so as to be used in doors that open and close by sliding on the vehicle body.

In the case of a sliding door, the particular structure of the door has some restrictions and problems, so that it has been impossible to connect the battery directly to an automatic door closing mechanism by means of electric cable. As a result, necessary power can be supplied to the automatic door closing mechanism by securing a first connector connected to a battery to the

vehicle body and by securing a second connector connected to the automatic door closing mechanism to the door. When the door is closed to its half-latched position, both the first and second connectors are connected to each other and supply power to the automatic door closing mechanism.

At least, both connectors respectively have a positive terminal and an earth terminal and each terminal is exposed, so that they contacted each other when the door is closing. Because the positive terminal and the earth terminal are exposed, water or metal chips may come into contact with the exposed terminals causing short-circuits. It is thus dangerous to constantly connect the positive terminal of the first connector to another positive terminal of the battery. According to the conventional technique for solving the problem above, a relay terminal is provided between the positive terminal of a first connector and the battery, and the relay is adapted to close when a switch provided on the vehicle body is pushed through the door turning the switch ON. Thus, power is supplied to the automatic door closing mechanism through the second connector only when the mechanism needs power.

However, it is very difficult to precisely synchronise the instant of the switch turning ON with the instant of both connectors coming into contact with each other. If the switch is not precisely secured, the supply of power to the automatic door closing varies is incorrectly timed. In addition, movable contacts of such a switch are provided in an exposed position resulting in low reliability and

malfunctioning.

Consequently, an object of the present invention is to provide a door lock apparatus with an automatic door closing mechanism having a switch for detecting positions of latch, which switch is adapted to keep its OFF condition between an open position and half-latched position, to keep its ON condition between half-latched position and full-latched position, and to keep OFF condition between full-latched poisition and over-rotated position in order to make control of automatic door closing smooth.

It is another object of the present invention to provide a door lock apparatus with an automatic door closing mechanism having a power transmitting mechanism provided between a latch and a motor, wherein automatic door closing is effected after the power transmitting mechanism returns to its initial position in order to attain a reliable automatic door closing.

Further, it is still another object of the present invention to provide a door lock apparatus with an automatic door closing mechanism for a sliding door.

Further and preferred features of the invention will become apparent from the appended claims.

Other features and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings wherein;

FIG 1 is an explanation view of whole construction and arrangement of the door lock apparatus with automatic door closing mechanism of the present invention,

FIG 2 is a sketch depicting interior of slide type door,

FIG 3 is a front view of a body of latch mechanism,

FIG 4 is a front view of latch and ratchet and etc, equipped on the body of latch mechanism,

FIG 5 is a rear view of latch mechanism,

FIG 6 is a section taken along line VI-VI of latch mechanism,

FIG 7 is a relation view of switch and a latch at its open position,

FIG 8 is a relation view of switch and a latch at its half-latched position,

FIG 9 is a relation view of switch and latch at its full-latched position,

FIG 10 is a relation view of switch and latch at its over-rotated position,

FIG 11 is a whole view of operation mechanism,

FIG 12 is a detailed view of the operation mechanism,

FIG 13 is an enlarged view depicting relationship among open lever and transmission lever and lock lever,

FIG 14 is a front view of base frame,

FIG 15 is a front view of open lever,

FIG 16 is a front view of communication lever,

FIG 17 is a front view of movement lever,

FIG 18 is a front view of lock lever,

FIG 19 is a front view of lever,

FIG 20 is a section of operation mechanism,

FIG 21 is a front view of rotation member,

FIG 22 is a front view of wire arm,

FIG 23 is a front view of movement lever,

FIG 24 is a front view of intermediate lever,

FIG 25 is a section of operation lever,

FIG 26 is an explanation view depicting a condition after manual safety mechanism operates,

FIG 27 is a block diagram of power supply controller of vehicle body and automatic door closing controller of door,

FIG 28 is a section of connector,

FIG 29 is a flow chart, and

FIG 30 is a mechanism of the prior art.

An embodiment of the door lock device with automatic door closing mechanism according to the present invention will be described with reference to the accompanying drawings. As shown in FIG 1, a vehicle body 1 of one-box type has a front side swing type door 2 and a sliding door 3 closed and opened by moving along a guide rail 4 of the vehicle body 1, which rail extends in front-and-rear direction. The sliding door 3 is provided with a latch mechanism 8 adapted to engage with a striker 10 secured to the vehicle body 1, an outer handle 5, a key cylinder 6, an inside lock member 7, and an operation mechanism 9.

As will be described later and as shown in FIG 27, the vehicle body 1 has a connector 129 connected to a battery 127 through an electricity supply controller 128. The sliding door 3 has a connector 124 connected to an automatic door closing controller 120 of the operation

mechanism 120. The connectors 129 and 124 do not contact each other when the door 3 is at its open condition. While the door 3 is open, power of the battery 127 is not supplied to the automatic door closing controller 120. When the door 3 moves to its closed position, both the connectors 129 and 124 come into contact with each other and power of the battery 127 is supplied to the automatic door closing controller 120 through the electricity supply controller 128. Then the controller 120 rotates an automatic door closing motor 40 of the operation mechanism 9, so that the door 3 is compulsorily closed.

The latch mechanism 8 will be explained with reference to FIG 3 to FIG 10. A synthetic resin body 11 of the latch mechanism 8 has an accommodation space 12 formed on a front side of the body 11. A latch 13 and ratchet 14 are rotatably attached in the accommodation space 12 through shafts 15 and 16. The body 11 has a transversely extending passage 17 through which the latch shaft 15 passes is formed above the passage 17.

As clearly shown in FIG 3 through FIG 6, the latch 13 has a stepped pin 21 formed on its rear side. The stepped pin 21 consists of a thick pin portion 22 and a thin pin portion 23 formed on a front end of the thick pin portion 22. The thick pin 22 is adapted to be inserted in an arc groove 19 of a radius around the shaft hole 18 and the thin pin 23 is inserted through an arc hole 20 formed at a bottom of the arc groove 19. As shown in FIG 6, the arc hole 20 is in a shape of through hole and a front end of

the pin 23 protrudes to the rear side of the body 11 through the arc hole 20. The arc groove 19 contains a coil spring 24 pushing the thick pin portion 22 so as to urge the latch 13 counterclockwise in FIG 4.

A latch arm 25 of about L shape is arranged on the rear side of the body 11. The latch arm 25 is rotatably journalled with the latch shaft 15. A front end portion of the latch arm 25 engages with the end portion of the thin pin portion 23 in order to rotate the latch arm 25 together with latch 13. A switch 26 detecting the rotational position of the latch 13 is placed above the latch arm 25. When the latch arm 25 rotates and the bent portion 27 of the latch arm 25 pushes the switch arm 28, the switch 26 turns ON. In addition, a back plate 53 is attached on the rear side of the body 11 and the latch arm 25 is placed between the back plate 53 and the body 11. A cover plate 57 is attached on the front side of the body 11.

FIG 7 through FIG 10, respectively show the relationship of rotation positions of latch 13 (latch arm 25) to the switch 26. FIG 7 shows the latch 13 at its open position. The bent portion 27 of the latch arm 25 is separated from the switch arm 28 and the switch 26 is at the OFF position when the latch 13 is at its open position. FIG 8 shows latch 13 at its half-latched position and ratchet 14 engaging with intermediate stepped portion 29 of the latch 13. In this condition, the bent portion 27 pushes the switch arm 28 and the switch 26 turns ON. FIG 9 depicts the latch 13 at its full-latched position and the

ratchet 14 engages with the main-stepped portion 31 of latch 13. Even in this condition, the switch arm 28 is pushed by the bent portion 27 and the switch 26 remains at its ON condition. FIG 10 shows latch 13 at its over-rotated position. In this position, bent portion 27 is separated from the switch arm 28 and switch 26 is at its OFF position. Thus, switch 26 is at its ON position when latch 13 is placed between a half-latched position and full-latched position and at its OFF position when latch 13 is placed at any other position. The automatic door-closing controller 120 controls rotation of the motor 40 according to signals from the switch 26.

Additionally, it should be noted that timing for actuation of the switch can be suitably fine-adjusted relative to timing of the half-latched position and full-latched position of the latch 13 according to various conditions of kind and weight of the vehicle door. According to general examples of set timing, the switch 26 is turned ON a littler early of the timing of half-latched position and turned OFF a little later of the timing of full-latched position.

A rotation shaft 32 is rotatably attached to an upper region of the body 11. A fan-like revolution lever 33 is secured to an end portion of the rotation shaft 32. The rotation shaft 32 rotates together with the revolution lever 33. Revolution lever 33 is made by bonding two metal plates 33A and 33B as shown in FIG 6. U-shaped groove 35 for guiding a wire 36 is formed on a circumferential

portion of the bonded metal plates 33A and 33B. A wire head 37 of wire 36 is adapted to engage with a hook 38 formed at an end portion of guide groove 35. The revolution lever 33 is urged in a counterclockwise direction in FIG 5 by means of a spring 39. Another end of the wire 36 is indirectly connected to the automatic door closing motor 40. When the motor 40 winds up the wire 36, the revolution lever 33 revolves clockwise in FIG 5 against elasticity of the spring 39.

As shown in FIG 4, a cooperative lever 41 is secured to front end of the rotation shaft 32. The rotation shaft 33 and cooperative lever 41 integrally rotate through rotation shaft 32. A pressing body 42 is journalled with front end of the cooperative lever 41 by means of a shaft 43. The pressing body 42 consists of a pair of plates 44, and a roller 46 journalled between both the plates 44 by a guide pin 45. A rear end of guide pin 45 protrudes toward the body 11 and in inserted through a guide groove 47 so formed on the body 11 as to extend substantially transversely.

As shown in FIG 3, a right-hand portion of the guide groove 47 is an arc groove 47A with a radius around a center of the shaft hole 18 and a left-hand portion of the groove 47 is an escape groove 47B extending in a direction away from the shaft hole 18.

The latch 13 has an engagement piece 48. When the latch 13 rotates to a half-latched position, the engagement piece 48 overlaps with the left end portion of the arc

groove 47A. When the latch 13 rotates to its full-latched position, the engagement piece 48 overlaps with the right end portion of the arc groove 47A.

When the latch 13 is placed at its half-latched position and the motor 40 winds up the wire 36, revolution lever 33 and cooperative lever 41 rotate, the pressing body 42 starts to slide from a position of FIG 4 to the right, and roller 46 of the pressing body 42 engages with an engagement piece 48 of the latch 13 placed at its half-latched position in order to rotate the latch 13 forcibly towards its full latching position.

As shown in FIG 5, a ratchet arm 49 rotatably supported on the ratchet shaft 16 is placed below the body 11. Ratchet arm 49 and ratchet 14 are mutually connected by a connection pin 51 passing rough a hole 50 formed in the body 11. The back plate 53 attached on rear side of the body 11 has a bent portion 53a placed at a left end side of the back plate 53. Intermediate lever 52 is rotatably journalled with the bent portion 53a through shaft 54. Intermediate lever 52 is connected to door opening handle or knob 5 through rod 78. When the handle 5 operates to rotate the lever 52, an end 55 of the lever engages with another end 56 of the ratchet arm 49 in order to rotate ratchet arm 49 clockwise. Thereby ratchet 14 is separated from the latch 13.

Next, the operation mechanism 9 will be described with reference to FIG 11 to FIG 26. The motor 40 and transmission or speed reduction 59 are secured to a base

frame 58 of the mechanism 9. In particular, as shown in FIG 14, shaft hole 60a is formed on a left side of the base frame 58, through which hole 60a a shaft 60 passes as shown in FIG 20. In addition, shaft 85 and shaft 60 are overlapped as shown in FIG 12 and FIG 13. Open lever 61 (FIG 15) is rotatably journalled with the shaft 60. The open lever 61 has three legs 62, 68 and 112. The first leg 62 has an arc hole 64 with which rod 63 extending to the outer handle 5 of the door 3 engages, and another arc hole 67 with which rod 66 extending to inner handle 65 of the door 3 engages. the second leg 68 has L shape groove 69. The L shape groove 69 consists of engagement groove 70 extending along a radial direction of the shaft 60 and an idling or invalidity groove 71 extending from front end of the engagement groove 70 and being bent at about a right angle. The third leg 112 has a pin 113. The open lever 61 is urged clockwise in FIG 12 by means of spring 72 which abuts against protrusion 73 of the base frame.

The shaft 60 rotatably supports a transmission lever (FIG 16) of L shape. The first arm 75 of the transmission lever 74 has an oval hole 76 corresponding to engagement groove 70 of the open lever 61. The second arm 77 of transmission lever 74 engages with end portion of the rod 78 extended to the intermediate lever 52 (FIG 5). Transmission lever 74 is urged clockwise in FIG 12 by means of spring 79 and abuts against protrusion 73 of the base frame 58.

A lock lever 80 (FIG 18) for moving the latch

mechanism 8 from its locked condition to an unlocked condition is rotatably journalled with the base frame 58 by a shaft 81. Lock lever 80 is connected to a rod 82 extended to the key cylinder 6 and another rod 83 extended to the inside lock operation member 7. A right end 87 of movement lever 86 is rotatably journalled with arm 84 of the lock lever 80 by a shaft 85. A pin 89 is attached to left end 88 of the movement lever 86 and the pin 89 engages with both oval hole 76 of the transmission lever 74 and L shape groove 69 of the open lever 61.

FIG 12 and FIG 13 show the lock lever 80 placed at its unlocked position when the pin 89 engages with both the oval hole 76 of transmission lever 74 and L shape groove 69 of the open lever 61. Consequently, both the open lever 61 and transmission lever 76 are at a condition of connection. As a result, when open lever 61 at its condition as shown in FIG 13 rotates counterclockwise by means of outer handle 5 or inner handle 65, the transmission lever 74 also rotates counterclockwise in order to rotate the intermediate lever 52 shown in FIG 5 through the rod 78. Consequently, it is possible to rotate the ratchet arm 49 clockwise disengaging the latch 13 from the ratchet 14.

The lock lever 80 is adapted to reach its locked position when it rotates counterclockwise from the position shown in FIG 12. When the lock lever 80 is placed at its locked position, the pin 89 has been moved to a front end portion of the engagement groove 70 and faces the invalidity groove 71. Thereby even counterclockwise

rotation of the open lever 61 cannot move the pin 89. Accordingly, the transmission lever 74 doesn't rotate and it is not possible to open the door.

A motor 90 for moving the lock lever 80 from its locked position to an unlocked position is secured to the base frame 58. A lever 92 is secured to an output shaft 91 of the motor 90 and a protrusion 93 formed at a front end of the lever 92 engages with a fork type portion 94 of the lock lever 80.

The base frame 58 has a shaft hole 95a formed at about the center of the frame, through which hole 95a a shaft 95 passes as shown in FIG 25. In FIG 12, the shaft 95 overlaps with a shaft 117. A rotation member 96 (FIG 21) is rotatably journalled with the shaft 95. A toothed portion or gear 98 engaging with a drive gear 97 secured to an output shaft of the speed reduction portion 59 is provided on the periphery of the rotation member 96. The base frame 58 has an arc groove 99 of a radius of shaft hole 95a and protrusion 100 integrally formed on rotation member 96 engages with the arc groove 99. FIG 12 shows an initial position of the rotation member 96. When the motor 40 rotates in a give direction, rotation member 96 rotates from the position shown along a direction shown by an arrow B. Rotation member 96 has an engagement groove 101 radially extending to the shaft 95. One 102 of side walls of the engagement groove 101 has a length longer than the other and the other side wall has a invalidity passage 103.

A wire arm 104 (FIG 22) is rotatably journalled with

the shaft 95. End portion of the wire 36 extended to latch mechanism 8 engages with one end of the wire arm 104. Another end portion 106 of wire arm 104 has an oval hole 107 corresponding to engagement groove 101 of the rotation member 96.

An intermediate lever 108 is rotatably journalled with the base frame 58 through shaft 109. The intermediate lever 108 is counterclockwise urged in FIG 12 by spring 111. One end portion 110 of the intermediate lever 108 abuts against the pin 113. Another end 114 of intermediate lever 108 is rotatably journalled with a base end 116 of the movement lever 115 by shaft 117. Front end 118 of the movement lever 115 has a pin 119 engaging with both of the cut-out groove 101 and oval hole 107.

When open lever 61 abuts against protrusion 73 as shown in FIG 12 by elasticity of spring 72, one end 110 of intermediate lever 108 abuts against pin 113 of the open lever 61 and a shaft 117 on another end 114 of the intermediate lever 108 corresponds to an axis of shaft 95. At this condition above, pin 119 of the movement lever 115 engages with both engagement groove 101 and oval hole 107, thereby rotation member 96 and wire arm 104 are integrally connected to each other. As a result, when the motor 40 rotates drive gear 97 in order to rotate the rotation member 96 along an arrow B, also wire arm 104 rotates in the arrow B direction, thereby wire 36 is wound up and revolution lever 33 rotates clockwise against the force of spring 24.

On the contrary, when handle 5 or 65 makes open lever 61 rotate counterclockwise in FIG 12, intermediate lever 108 is pressed by pin 113 and rotates clockwise around shaft 109, pin 119 of movement lever 115 moves in engagement groove 101 so as to apart from the shaft 95, and is displaced to face the invalidity passage 103. In this condition, the rotation member 96 is disconnected from wire arm 104. As a result, when handle 5 or 65 is operated while operation of motor 40, the rotation member 96 keeps its rotation due to motor 40 along an arrow B as shown in FIG 26. However, the wire arm 104 returns to its initial position, because a force of resiliency of spring 39 attached to the revolution lever 33 functioning along an arrow A is applied to the wire arm 104 through wire 36. A manual safety mechanism cuts off or breaks such power communication.

The automatic door closing controller 120 is attached to the base frame 58. The controller 120 consists of cable 121 extended to the switch 26, cable 122 to the motor 40, cable 123 to the connector 124, and cable 131 to motor 90 (FIG 12).

Structures of the connector 124 and another connector 129 will be described with reference to FIG 27 and FIG 28. Connector 124 has a positive terminal 134a, an earth terminal 134b, and a signal terminal 134c. Respective terminals are connected to three codes 123a, 123b, and 123c of the cable 123 extended to the controller 120. The connector 124 has a pair of terminals 136a and 136b

connected to cable 125 of motor 90 in order to operate the lock lever 80. Five terminals of the connector 124, respectively are spring biased to protrude to the outside.

The connector 129 formed on the vehicle body 1 has three terminals 133a to 133c, respectively corresponding to the terminals 134a to 134c, and a pair of terminals 135a and 135b corresponding to terminals 136a and 136b. Respective terminals 133a to 133c are spring biased outwardly and are connected to power supply controller 128 of the body 1 by cords 126a to 126c of cable 126. The terminals 135a and 135b are connected to the power supply controller 128 by cable 132.

Terminals 133a to 133c of the connector 129 and terminals 134a to 134c of the connector 124 come into contact when the door 3 opens to its predetermined position. The instant of the contact is determined so as to occur before the latch 13 engages with the striker 10 and reaches its half-latched condition. Contact time is not strictly determined. For example, these terminals above are determined to come into contact when the striker 10 enters the passage 17.

According to the function of the power supply controller 128, contact detection voltage is applied to signal terminals 133c through the cords 126c and the terminals 133a to 133c come into contact with the terminals 134a to 134c. Then current is fed from signal terminal 133c to automatic door closing controller 120 through signal terminal 134c and returned to earth terminal 133b of

the body 1 through earth terminal 134b of the door 3. That is, no current is fed to signal terminal 133c of the body 1 when the door is open since the signal terminal 133c is free. However, when terminals come into contact with each other making an electric loop, current flows therethrough. When current flows, the power supply controller 128 determines that connectors are in contact with each other and supplies current from battery 127 to positive terminal 133a through the cord 126a. Consequently, current necessary to rotate or drive the motor 40 is supplied to the automatic door closing controller 120.

As described above, according to the present invention, mutual contact of connectors is detected reliably by current flowing attained by contact of the connectors. In addition, because an exposed structure of the switch is not used, it is possible to obtain high reliability.

Because respective terminals of the connector 124 and 129 are exposed, it is necessary to separate the positive terminal 133a from the earth terminal 133b preventing these terminals 133a and 133b from accidently contacting each other and making a short circuit. Between the positive terminal 133a and the earth terminal 133b, there are terminals 135a and 135b, respectively connected to the motor 90 for controlling the locking condition. Respective terminals 134a to 134c and 136a to 136b of the connector 124 are so arranged as to match with the structure of the connector 129.

The automatic door closing controller 120 has a dector 130 for detecting a rotation condition of the motor 40. According to the door lock device of the present invention, the detector 130 uses an ammeter to detect motor current and thus rotation and stopping of the motor 40. The structure of the detector is not restricted to that of the detector 130 and various kinds of the detector may be employed.

Operation of Automatic Door Closing

Because the connector 124 of the door 3 doesn't contact with the connector 129 to the body 1 while the door is open, no current is supplied to the automatic door closing controller 120 of the door 3. And because the latch 13 is placed at its open position, the switch 26 is at its OFF condition. In practise, current is not supplied to control 120 and the switch 26 fails to function. Power supply controller 128 of the vehicle body 1 is applying voltage to the signal terminal 133c through cord 126c of the connector 129 in order to detect the contact condition.

When the sliding door 3 is manually slid in its closing direction, terminals 134a-c of connector 124 and terminals 133a-c of connector 129 are come into contact before the latch 13 reaches its half-latched position. Then, voltage applied to the signal terminal 133c feeds current from signal terminal 133c to automatic closing controller 120 through signal terminal 134c. Then, current returns to earth terminal 133b of the vehicle body 1 through the earth terminal 134b of door 3. As described

above, when current flows, it is detected by the power supply controller 128 that connectors are in contact with each other and power of the battery 127 is supplied to the automatic door closing controller 120 through positive terminals 133a and 134a at Step 3 of the flow chart shown in FIG 29.

The controller 120 receiving power confirms the position of latch 13 by means of a signal sent from the switch 26 and is kept at its present condition until the latch 13 reaches its half-latched condition at Step 4. When the door 3 further moves by its inertia and the latch 13 rotates to its half-latched position shown in FIG 8, the bent portion 27 of latch arm 25 connected to latch 13 via stepped pin 21 presses the switch arm 28 to switch 26 making the switch 26 turn ON.

When the switch 26 turns ON, the controller 120 supplies electricity to reversely rotate the motor 40 at Step 5 in order to rotate the rotation member 96 along a counterclockwise direction as shown in FIG 12 and to firmly return the rotation member 96 to its initial position. After rotation member 96 returns to its initial position, protrusion 100 of the rotation member 96 abuts against end portion of arc groove 99 of the base frame 58 attaining a mechanically locked condition and stopping the motor 40. As a result, the current drawn by the motor 40 changes and such change is directed by a detector 130 at Step 6.

When the rotation member 96 returns to its initial position, controller 12o supplies current to rotate the

motor 40 in the given direction in order to rotate the rotation member 96 along the arrow B at Step 7. Then pin 119 of the movement lever 115 engages with both engagement groove 101 of rotation member 96 and oval hole 107 of the wire arm 104, so that also wire arm 104 rotates along the arrow B direction to wind up the wire 36 and the revolution lever 33 rotates clockwise in FIG 5.

When revolution lever 33 rotates, the cooperation lever 41 rotates counterclockwise in FIG 4 through rotation shaft 32 and the pressing body 42 is guided by groove 47 and moves to the right. Then, roller 46 of the pressing member 42 abuts against an engagement piece 48 of the latch 13 placed at its half-latched position so as to forcibly rotate the latch 13 clockwise to is full-latched position. However, when the latch 13 is kept at its full-latched position, the switch 26 is still at its ON position, so that the motor 40 rotates continuously and latch 13 rotates beyond its full-latched position as shown in FIG 10. Then, switch 26 is turned to OFF at Step 8.

When switch 26 is turned to OFF, controller 120 detects that latch 13 has rotated to its overrun position. Thus, the motor 40 is reversely rotated at Step 9. Consequently, rotation member 96 and wire arm 104 rotate in the counterclockwise direction B, thereby wire 36 is lessened, revolution lever 33 rotates counterclockwise due to the elasticity of spring 39, and the pressing body 42 returns to its original position. In addition, latch 13 returns to its full-latched position due to elasticity of

spring 24 and the main stepped portion 31 of the latch 13 engages with ratchet 14.

Reverse rotation of motor 40 causes the rotation member 96 to return to its initial position, thereby protrusion 100 of the rotation member 96 abuts against the end portion of arc groove 99 of base frame 58 attaining a mechanically locked condition and stopping the motor 40.

As a result, current drawn by the motor 40 changes and detector 130 detects such change at Step 10. Thus, controller 120 stops current supply to the motor 40 at Step 11 and a finish or end signal is sent to the power supply controller 128 of vehicle body 1. When power supply controller 128 receives the finish signal, it stops current supply to positive terminal 133a at Step 13.

Safety mechanism

While the power of motor 40 moves the latch 13 from its half-latched position to its full-latched position, the switch 26 is kept at the ON condition at Step 8. Then, the detector 130 monitors the rotary condition of the motor 40 at Step 14. If it detects stopping of the motor 40, an emergency is assumed and instantly the motor 40 is rotated reversely at Step 9. Occurrence of an emergency means that foreign matter is caught in the door 3 while the door is being closed and the motor 40 stops, or that the switch 26 is faulty and fails to detect overrun or overrotation of the latch 13.

Additionally, when a hand is caught in the door 3 while the door is automatically closing, such accident is

taken account of, and as stated above the detector 130 detects trouble of the motor 40 and causes the motor 40 to rotate reversely. however, it is necessary to positively operate the automatic manual mechanism before the controller 120 functions to provide its automatic safety controlling operation.

According to the door lock apparatus of the present invention, when a hand is caught in the door 3, instantly or as soon as possible outer handle 5 or inner handle 65 is operated in order to rotate the open lever 61. Then, pin 113 of the open lever 61 makes shaft 109 of the intermediate lever 108 rotate clockwise around shaft 109, and pin 119 of the movement lever 115 disengages from the engagement groove 101 of rotation member 96 and moves to a position facing the invalidity passage 103.

As a result, because rotation member 96 and wire arm 104 which have been connected through pin 119 are disconnected, power of the motor 40 is not transferred to the wire arm 104 and automatic powered door closing stops. As described above, after the rotation member 96 is disconnected from the wire arm 104, load of the motor 40 lowers suddenly resulting in a change of current value or rotational speed. When such change is detected by detector 130 at Step 15, the controller 120 considers that it is a result of operation of manual safety mechanism and confirms the position of lock lever 80 at Step 16. When the lock lever 80 is at its unlocked position, the motor 40 is immediately reversely rotated at Step 9.

Necessity of confirmation of position of the lock lever 80 will be explained. When the lock lever 80 is at its unlocked position and the manual safety mechanism functions, the open lever 61 rotates and transmission lever 74 also rotates through pin 89 resulting in rotation of intermediate lever 52 shown in FIG 5 through rod 78. An end portion 55 of the intermediate lower 52 rotated comes into contact with another end portion 56 of the ratchet arm 49 in order to rotate the ratchet arm 49 and also the ratchet 14 connected to the ratchet arm 49 through connection pin 51. As a result, ratchet 14 is disengaged from latch 13. When the manual safety mechanism is operated in the unlocked condition of the lock lever 80, automatic door closing operation by the motor 40 stops and the door 3 will open.

On the contrary, when lock lever 80 is at its locked position, even if open lever 61 rotates, the transmission lever 74 doesn't rotate and it is impossible to disengage ratchet 14 from the latch 13. Accordingly, even if latch 13 reversely rotates to an open position due to resiliency of spring 24 after the latch 13 is made free from motor 40, ratchet 14 engages with intermediate stepped portion 29 retaining the latch 13 in its half-latched condition and failing to open the door. This is a problem of the prior art.

In order to solve such problem of the conventional door lock apparatus by the present invention, when the manual safety mechanism operates, the position of the lock

lever 80 is confirmed. When the lock lever 80 is placed at its locked position, controller 120 feeds current to the motor 90 to move lock lever 80 to its unlocked position at Step 17. As stated above, when lock lever is at its locked position and the manual safety mechanism operates, the automatic door closing operation by the motor 40 stops, and lock lever 80 is moved to the unlocked position. Then, again handle 5 or 65 is operated to rotate the open lever 61 and the door 3 is able to open since the lock lever 80 has been at its unlocked position. In short, at any situation, when handle 5 or 65 is operated twice, the door 3 is able to open.

Door re-closing operation after Manual Safety Mechanism Operation

When the outer handle or inner handle operates the manual safety mechanism while the motor 40 automatically closes the door, forcible closing of door stops and also the door 3 opens. When door 3 is open, connector 128 at the vehicle body 1 and connector 124 at door 3 are apart from each other, so that at this instant of separation electricity supply to controller 120 stops. As a result, motor 40 loses power and rotation member 96 stops at its mid position. In addition, when operation of the manual safety mechanism moves pin 119 into the invalidity passage 103 of the rotation member 96, wire arm 104 is pulled along arrow A direction through wire 36 owing to elasticity of the spring 39 attached to the revolution lever 33 and returns to the initial position of wire arm 104. FIG 26

depicts the condition of wire arm 104 at its original position. As clearly shown in FIG 26, when the rotation member 96 stops at its mid position, pin 119 is kept at its position engaged with invalidity passage 103. In this situation, even if motor 40 is again operated and the rotation member 96 rotates in arrow B direction, rotation member 96 fails to move the pin 119 resulting in non-operation of automatic door closing.

According to the present invention, as already described concerning operation of the automatic door closing, the motor 40 rotates reversely at Step 5 in order to return rotation member 96 to its initial position. When rotation member 96 is returned to the initial position, pin 119 engaged with the invalidity passage 103 enters engagement groove 101 owing to the elasticity of spring 111 and rotation member 96 is again connected to the wire arm 104, attaining a condition in which automatic door closing is possible.

Operation of Manual Door Closing

Next, manual door closing will be explained. When the sliding door 3 in its open condition is slid strongly by hand, latch 13 of the latch mechanism 8 engages with striker 10 of the vehicle body 1, as is well known, due to the large inertia of the door 3, and the latch 13 rotates to its full-latched position. Then, ratchet 14 engages with the main stepped portion 31 of the latch 13 and the door 3 is closed without the power to the motor 40.

In manual door closing operation, the switch 26 is

closed by rotation of the latch 13 and controller 120 accordingly controls the motor 40. In the subsequent automatic door closing operation, the switch 26 instantly changes to the open condition, so that completion of the closing operation is detected and the motor 40 starts its reverse rotation after motor 40 has moved for only a few rotations.

Other Operation

When the sliding type door 3 is closed, although the latch 13 engaged with striker 10 rotates to its half-latched position, ratchet 14 sometime cannot engage with the intermediate stepped portion 29 of latch 13 and latch 13 returns to its open position owing to elasticity of the spring 24. According to the present invention, the motor 40 is adapted to rotate in the given direction while the switch 26 is at its ON condition, so that the latch 13 disengaging from the striker 10 is not rotated to its full-latched position even in this condition.

Claims

1. A door lock apparatus for a door adapted to slide on a vehicle body so as to be opened and closed, comprising;

a power supply unit provided on the vehicle body and having a first controller connected to an electric battery and a first connector connected to the first controller, said first connector having a first terminal group consisting of a positive terminal exposed to the outside, an earth terminal, and a signal terminal;

a power receiving unit provided on the door and having a second connector and a second controller connected to the second connector, said second connector having a second terminal group consisting of a positive terminal exposed to the outside, an earth terminal, and a signal terminal, said second terminal group being adapted to mutually contact with the first terminal group when the door is closed to a predetermined position;

a latch provided on the door so as to engage with a striker secured to the vehicle body;

a first motor connected to the second controller so as to rotate the latch towards a full-latched position when the motor rotates in a given direction;

wherein the first controller is adapted to apply a predetermined voltage to a signal terminal of the first terminal group and to supply an electric current to the earth terminal of the first terminal group from the signal terminal of the first terminal group through the second controller when the first terminal group comes into mutual contact with the second terminal group, and the arrangement being such said first

controller supplies power of the battery to the second controller, when the first controller causes current to flow to the earth terminal, through both positive terminals.

2. A door lock apparatus according to claim 1, wherein each positive terminal is placed relatively near the signal terminal and each earth terminal is spaced apart from the positive terminal or the signal terminal by a predetermined gap.

3. A door lock apparatus according to claim 2, further comprising an opening lever for releasing engagement of the latch with the striker, a lock lever movable between a locked position and an unlocked position, for preventing operation of the opening lever when the lock lever is in the locked position, and a second motor for moving the lock lever from its locked position to its unlocked position, and wherein said second connector has a third terminal group connected to the second motor, the third terminal group being placed in a predetermined gap, and wherein the first connector has a fourth terminal group corresponding to the third terminal group.

The Patent Office

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): E2A(AMXF, AAH)

Int Cl (Ed.6): E05B-047/00, -065/32.

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
	NONE	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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